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$$\begin{vmatrix} {}_3C_2 & 0 & 0 & 0 & 1 \\ {}_5C_2 & {}_5C_4 & 0 & 0 & 3 \\ {}_7C_2 & {}_7C_4 & {}_7C_6 & 0 & 5 \\ {}_9C_2 & {}_9C_4 & {}_9C_6 & {}_9C_8 & 7 \\ {}_{10}C_2 & {}_{10}C_4 & {}_{10}C_6 & {}_{10}C_8 & 8 \end{vmatrix} = 0, \qquad \text{and} \qquad \begin{vmatrix} {}_4C_2 & 0 & 0 & 0 & 2 \\ {}_6C_2 & {}_6C_4 & 0 & 0 & 4 \\ {}_8C_2 & {}_8C_4 & {}_8C_6 & 0 & 6 \\ {}_{10}C_2 & {}_{10}C_4 & {}_{10}C_6 & {}_{10}C_8 & 8 \\ {}_9C_2 & {}_9C_4 & {}_9C_6 & {}_9C_8 & 7 \end{vmatrix} = 0,$$

which show at once the scheme for writing out the corresponding determinants of order $n + 1$.

Let us consider the determinant on the left. Subtract three times the last column from the first. The first element in the first column becomes zero, and the other elements take the form

$${}_rC_2 - 3(r - 2) = \frac{r^2 - 7r + 12}{1\cdot 2} = \frac{(r - 3)(r - 4)}{1\cdot 2} = {}_{r-3}C_2.$$

When we expand with reference to the first row we obtain

$$\begin{vmatrix} {}_2C_2 & {}_5C_4 & 0 & 0 \\ {}_4C_2 & {}_7C_4 & {}_7C_6 & 0 \\ {}_6C_2 & {}_9C_4 & {}_9C_6 & {}_9C_8 \\ {}_7C_2 & {}_{10}C_4 & {}_{10}C_6 & {}_{10}C_8 \end{vmatrix} = 0.$$

A corresponding reduction of the other determinant can be made.

In the first determinant multiply the first four columns by 2, 4, 6, 8, respectively, and divide the rows by 3, 5, 7, 9, 10, respectively, and we obtain

$$\begin{vmatrix} {}_2C_1 & 0 & 0 & 0 & \frac{1}{3} \\ {}_4C_1 & {}_4C_3 & 0 & 0 & \frac{3}{5} \\ {}_6C_1 & {}_6C_3 & {}_6C_5 & 0 & \frac{5}{7} \\ {}_8C_1 & {}_8C_3 & {}_8C_5 & {}_8C_7 & \frac{7}{9} \\ {}_9C_1 & {}_9C_3 & {}_9C_5 & {}_9C_7 & \frac{8}{10} \end{vmatrix} = 0,$$

a similar transformation being possible for the second determinant.

Various other transformations of the original determinant are of course possible. A direct proof of the vanishing of some of these determinants might be of interest.

II. Relating to the Teaching of Logarithms.

By T. M. Simpson, University of Wisconsin.

The present note is the result of observations made in teaching logarithms to a large number of students. In departing somewhat from current textbook practice, I have secured such uniformly good results that I feel there is merit in the method.

By way of introduction the class is drilled, if necessary, on the two laws of exponents which apply in logarithmic work:

$$10^m \times 10^n = 10^{m+n}, \text{ and } (10^m)^n = 10^{mn},$$

where the numbers, m and n, are positive or negative, integral or fractional, or zero.

The point of departure is now the equation,

$$10^L = A.$$

It is stated that this is also written, $L = \log A$, read "L is the logarithm of A." It is pointed out that A is necessarily positive. With no further preparation the class can now easily translate such forms as

$$10^2 = 100, \qquad \frac{10^2 \times 10^{-3}}{10^5} = 10^{2-3-5} = 10^{-6},$$

$$10^{-3} = .001, \qquad 10^{3.2} \times 10^{2.1} = 10^{5.3},$$

into the language of logarithms. Thus they get clearly in mind the concept of a logarithm as an exponent.

The proofs of the fundamental theorems may be treated as exercises in translating statements of exponent laws into logarithmic form. At first, however, the proofs are passed over rather lightly but the facts are insisted upon strongly.

Next, by a few concrete examples, it is shown that the logarithms of numbers having the same sequence of figures differ only by integers.

Take, for illustration, the equation, $10^L = 382$; multiply both members by 10, 10^2, 10^{-3}. The logarithm of 382 being L, the logarithms of 3820, 38200, .382, are seen to be, respectively, $L + 1$, $L + 2$, $L - 3$. Such examples as this lead directly to the observation that any number a can be written in the form $a' \times 10^n$, where a' is between 1 and 10, and n is a positive or negative integer or zero. This statement is not given to the student in the form written above. The situation is made clear to him and the idea is so simple that he may safely be left to formulate the statement for himself.

n is then the characteristic of the logarithm of a. No other rules for characteristics are given. This is a distinct gain over the usual method where there are four rules—two for direct, and two for inverse use of the tables. That the advantage is real is proved by the fact that students quickly see that the characteristic is given by the number of places they must move the decimal point from units' place to put the number in the form $a' \times 10^n$, and that they have little trouble in working both directly and inversely with the tables.

In computing with logarithms, I question the advantage of writing the characteristic -1 in the form $9. - 10$, and similarly for other negative characteristics. Why not say that if a characteristic is positive it can of course be written before the mantissa, but if negative it must be placed after it? Thus, log .2 is $.3010-1$, log .02 is $.3010-2$, etc. In this way the actual characteristic appears with the logarithm, and labor in computation is somewhat cut down.

If it is required to divide $.3010-1$ by 3, change the logarithm to $2.3010-3$. The student is made to see that he has an expression of the form $c+m-c'$ in which c and c' may be changed at pleasure, provided their difference remains constant. This leads naturally to the anticipation of another difficulty of the student, which is illustrated by the following problem. It is required to solve the equation, $.2 = .3^x$. The student easily obtains the result

$$x=\frac{\log .2}{\log .3}=\frac{9.3010-10}{9.4771-10},$$

and is unable to proceed. Perhaps I should say that three quarters of the class subtract the denominator from the numerator while, of the remainder, some know enough not to subtract but do not know what to do. My experience shows the curious fact that if the above result is written $\frac{.3010-1}{.4771-1}$ many more members of the class will see the correct procedure from this point. Most of the others will handle the fraction correctly if, just before the assignment of this type of problem, the instructor states that, when it is required to multiply or divide by a negative logarithm, the characteristic and mantissa are no longer separated (as always in addition or subtraction) but are combined. So if we wish to add or subtract log .2, we write it $.3010-1$, but if we wish to use it as a multiplier or divisor, we combine the parts and write it $-.6990$. This fact is seldom explicitly stated in the books and is such a stumbling block to the student that it seems wise to state it.

CORRESPONDENCE.

NOTE. A correspondent asks to be told something about descriptive geometry as a course of more than professional engineering concern. The Editors have asked Professor W. H. ROEVER, of Washington University, to frame a reply to this question, and we print it in full below since we believe it to be of interest to MONTHLY readers in general.

TO THE EDITORS OF THE MONTHLY:

In accordance with your request I submit the following reply to the question of your correspondent:

From my conversations and correspondence with various mathematicians in this country I have been led to the conclusion that many do not have a very clear notion of what descriptive geometry really is. Hence, I will first attempt to state precisely and concisely the nature and object of this branch of applied mathematics.

It is evident that drawing is done in a plane or on a surface. Hence graphical processes are executed in a plane (or on a surface). On the other hand the applied sciences frequently demand a graphical solution for the problems of space